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A NEW TROGLOBITIC CRAYFISH OF THE GENUS
CAMBARUS (DECAPODA, ASTACIDAE) FROM
ARKANSAS WITH A NOTE ON THE
RANGE OF *CAMBARUS CRYPTODYTES* HOBBS¹

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In a survey of the troglobitic crayfishes of the genus *Cambarus*, Hobbs and Barr (1960: 14) indicated that these animals occur "in three geographically disjunct cave regions: the Ozark region in which is found *C. setosus* and *C. hubrichti*; the Tennessee Valley in northern Alabama and southern Tennessee occupied by *C. hamulatus*, *C. jonesi* and *C. cahni*; and the Florida Panhandle region, in which *C. cryptodytes* is the only representative, known from a single locality."

Hobbs and Barr (*loc. cit.*) overlooked the reference to *C. cryptodytes* by Pylka and Warren (1958) in their report on *Haideotriton wallacei*. Through their work and the subsequent study of Warren (1961), *C. cryptodytes* is now known from the following localities: Gerard's Cave, Judge Cave, Pottery Cave, Soda Straw Cave, and Washed-out Cave, Jackson County, Florida, and from Climax Cave, Decatur County, Georgia.

The present paper describes a new species, *C. zophonastes*, from the Ozark region. This species, known from a single locality, is the third species of troglobitic crayfish described from the region and the first from Arkansas. *Cambarus zophonastes* has its closest affinities with *C. setosus* Faxon (1899: 237) which is known from a number of localities in southwestern Missouri (Hobbs and Barr, 1960: 27).

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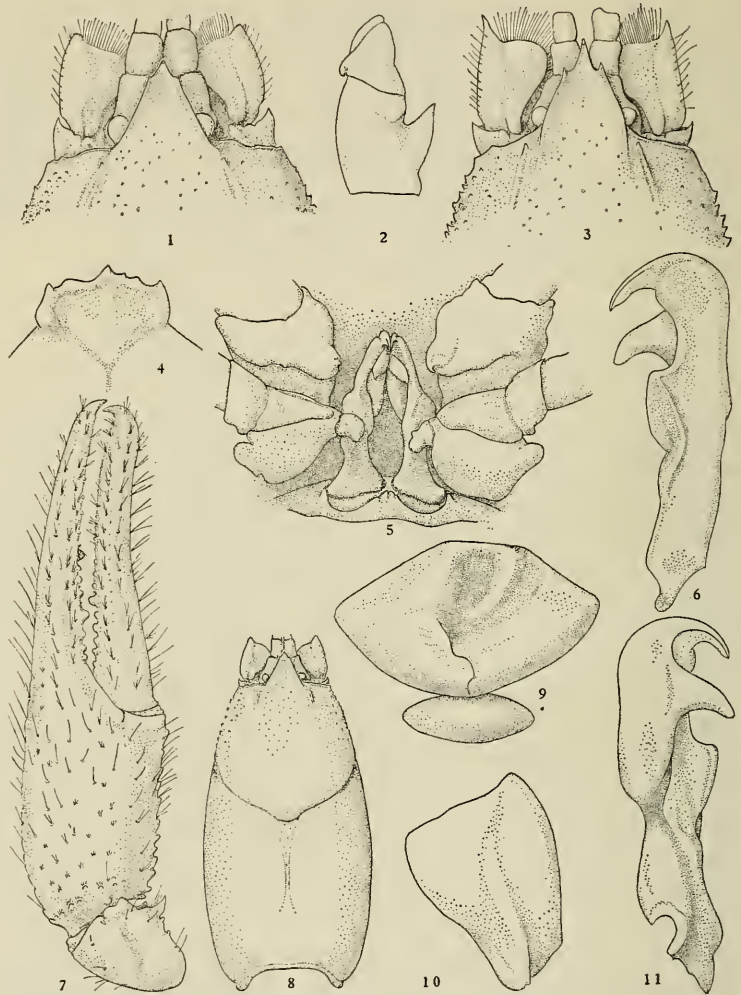


PLATE I. Fig. 3 is *Cambarus setosus* Faxon; all others are *Cambarus zophonastes*, sp. nov. 1, Dorsal view of cephalic region; 2, Basipodite and ischiopodite of third pereopod of male, form I; 3, Dorsal view of cephalic region of *C. setosus*; 4, Epistome; 5, Bases of fourth and fifth pereopods and first pleopods of male, form I; 6, Lateral view of first pleopod of male, form I; 7, Distal podomeres of cheliped of male, form I; 8, Dorsal view of carapace; 9, Annulus ventralis; 10, Antennal scale; 11, Mesial view of first pleopod of male, form I.

Cambarus zophonastes,* new species

Diagnosis.—Albinistic; eyes reduced and without pigment; rostrum broadest at base and with small marginal spines; margins strongly convergent and acumen reaching only slightly cephalad of distal margin of basal segment of antennule; postorbital ridges strongly depressed and terminating cephalically in weak tubercles; areola narrow (more than 29 times longer than broad); one to several lateral tubercles on carapace which may or may not be spiniform, never more prominent than tubercles on cephalolateral surface of carapace; chelae conspicuously setose with a single well-defined row of tubercles along inner margin of palm. First pleopod of male and annulus ventralis of female as figured.

Holotypic Male, Form I.—Albinistic, eyes reduced. Body subovate, markedly depressed. Abdomen narrower than thorax (16.3 and 12.0 mm in widest parts, respectively). Width of carapace greater than depth in region of caudodorsal margin of cervical groove (16.3 and 10.1 mm); greatest width of carapace slightly cephalic to midlength of areola.

Areola narrow, 29.2 times longer than wide with one punctation in narrowest part. Cephalic section of carapace 1.2 times longer than areola; length of areola 46.2 per cent of entire length of carapace. Rostrum with non-thickened, strongly convergent margins bearing corneous marginal spines; upper surface slightly concave with the usual submarginal row of setiferous punctations, scattered setiferous punctations in basal half. Acumen short with corneous up-turned tip and extending cephalad just beyond distal end of basal segment of antennule. Subrostral ridges poorly developed and evident in dorsal aspect for only a short distance at base of rostrum. Postorbital ridges strongly depressed, each with a conspicuous groove and terminating cephalically in very weak tubercles. Suborbital angles weak, that on left obtuse and that on right broadly rounded. Branchiostegal spine small but acute. Surface of carapace punctate dorsally and strongly granulate laterally; granules becoming tuberculate ventrally, those on cephalolateral portions of carapace tuberculate and subspiniform; several small tubercles present in area usually occupied by lateral spines, only one conspicuously spiniform and it not larger than those tubercles on cephalolateral portions of carapace.

Abdomen longer than carapace (33.2 and 31.6 mm). Cephalic section of telson with four spines in sinistral corner and two in dextral.

Epistome (Fig. 4) much broader than long, with elevated margins provided with an anteromedian spine and a pair of lateral spines. Antennules of the usual form with strong spines on lower surface of basal segment slightly distal to midlength. Antennae extending caudad beyond caudal margin of telson. Antennal scale (Fig. 10) conspicuously broad with heavy lateral portion terminating cephalically in a broad triangular extension devoid of a spine; lamellate portion suddenly broadened in distal half; broadest portion slightly distal to midlength.

* Gr., *zophus*, nether darkness; so named because of its subterranean habits.

Left chela (Fig. 7) elongate, subovate in cross section and with palm inflated; dactyl of right chela regenerated. All surfaces bearing setiferous punctations. Inner margin of palm with a row of 12 tubercles flanked proximally by additional tubercles below this row; proximal upper surface of palm with scattered tubercles and lower mesial surface with a few; lateral margin of palm with scattered tubercles extending almost to base of movable finger; lower distal margin of palm with a conspicuous tubercle at base of dactyl. Opposable margin of immovable finger with a row of 12 tubercles, fourth from base largest; a prominent tubercle below this row between seventh and eighth tubercles; fingers not gaping and both with submedian longitudinal elevations above and below. Opposable margin of dactyl with a row of 17 tubercles along proximal four-fifths of finger, sixth from base largest; mesial margin with a single tubercle at base; otherwise, both fingers bearing conspicuous setiferous punctations. Opposable margins of both fingers with a single row of minute denticles between and distal to aforementioned tubercles.

Carpus distinctly longer than broad with an oblique furrow on upper surface; upper surface punctate. Mesial surface tuberculate with one large tubercle and several smaller ones proximal to it; lower mesiodistal margin with a prominent spike-like tubercle and lower laterodistal margin with a prominent projection opposing articular knob on palm; four small tubercles arranged in an arc proximal to laterodistal tubercle.

Upper surface of merus with many small tubercles forming a row on proximal portion; lateral and mesial surfaces irregular but without punctations or tubercles except for a few tubercles near distal margin; lower mesial surface with a row of 12 spike-like tubercles and a lateral row of 10, the distal five of which extend mesiodistally across distal portion of podomere. Ischium with a ventral row of three small tubercles; otherwise punctate.

Hooks (Fig. 2) on ischiopodites of third pereopods only; hooks strong and simple. Caudomesial surface of coxopodites of fourth pereopods with prominent projections (Fig. 5), those on fifth without prominences.

First pleopods (Figs. 5, 6, 11) symmetrical and extending cephalad to coxopodites of third pereopods when abdomen is flexed. Tips terminating in two distinct parts reflexed at angles greater than 90 degrees. Mesial process non-corneous, inflated and tapering gently to apex but not bulbiform; central projection corneous and not conspicuously notched near apex.

Allotypic Female.—Differs from the holotype in the following respects: right suborbital angle obtuse, left obsolete; telson with two spines in each caudolateral corner; inner margin of palm of chela with nine tubercles, opposable margin of immovable finger with 10 tubercles, corresponding margin of dactyl with 13 tubercles, and lower laterodistal margin of carpus with spine on articular process.

Annulus ventralis (Fig. 9) slightly movable. Cephalomedian area with a prominent depression, deepest toward caudodextral thickened

wall; tongue sinistral and forming caudosinistral surface of depression; sinus, originating in depression dextral to median line, extends caudo-sinistral across median line onto caudal wall, turning, in a gentle arc, caudodextral to mid-caudal margin of annulus.

Measurements.—As follows (in millimeters):

Carapace	Holotype	Allotype	Paratypic ♂	Paratypic ♂	Paratypic ♀
Height	10.1	9.2	9.1	9.8	8.0
Width	16.3	13.4	14.2	13.2	10.9
Length	31.6	26.9	25.9	27.3	22.5
Rostrum					
Width	4.4	3.8	3.5	4.0	3.2
Length	4.5	4.1	3.5	4.1	3.5
Areola					
Width5	.4	.3	.3	.3
Length	14.6	12.2	12.0	11.9	9.3
Chela					
Length, inner					
margin of palm ..	14.0	10.8	12.0	11.1	8.3
Width of palm	10.7	8.4	9.5	8.0	6.2
Length, outer					
margin of hand ..	41.4	28.9	33.0	32.4	23.5
Length of dactyl ...	24.6	16.3	19.4	19.1	13.6

Type Locality.—The type locality of *Cambarus zophonastes* is Hell Creek Cave, Stone County, Arkansas (NE¼, NE¼, Sec. 30, T. 15 N, R. 10 W). Hell Creek Cave is developed in the Plattin Limestone of Ordovician Age. The length of the cave, measured principally along the course of the stream that flows through it, is about 1,500 feet. The cave stream issues as a spring from the east side at the bottom of a V-shaped valley. This spring and another which issues from a small cave on the west side of the valley make up the perennial flow of Hell Creek.

The main entrance to Hell Creek Cave is about 50 feet above the bottom of the valley. The cave stream is first encountered about 150 feet from the cave entrance. At this point the stream exits from the traversible portion of the cave by flowing through a water-filled channel to the spring outlet. The stream can be followed continuously from this point of first encounter to the end of the traversible portion of the cave.

The crayfish were collected from the cave stream within a distance of 30 feet from where the stream is first encountered. This portion of the cave, 150 feet from the entrance, is in perpetual darkness. Here the stream fills the lower portion of a vertical, joint-controlled solution channel. The stream is 3 to 4 feet wide and ranges in depth from 1 to 14 feet, being deepest where the stream enters the water-filled channel.

The temperature of the water, measured on 3 October 1961, was 58°F and, on 7 November 1961, was 56°F. Normal flow of the stream is estimated to be about 200 gallons per minute. Flow of the stream increases within a short time after moderate rainfall in the vicinity.

An epigean crayfish, *Orconectes neglectus* subsp., was collected at the same location as the troglobitic forms. Also, an epigean species of fish was observed in this location. This indicates that the cave is accessible to small aquatic organisms from the outside by way of the spring opening.

Habits.—Specimens of *Cambarus zophonastes* were observed on the steep rock sides and on the mud bottom of the cave stream. The crayfishes showed no obvious response to light of lanterns; however, they crawled slowly while being observed. They were apparently sensitive to turbid water, made by mud stirred up from the bottom of the stream, and were aware of disturbances in the water made when being approached. To avoid turbid water, some specimens crawled up the sides of the stream to clearer water near the top. Others bided their time on the bottom until the water cleared, or retreated to the deeper portions of the stream. The crayfish were sensitive to touch and swam quickly if not captured on first contact.

Disposition of Types.—The type series of five specimens are deposited in the U. S. National Museum: holotypic male, form I (No. 108356), allotypic female (No. 108357), two paratypic males, form I, and a paratypic female.

Relationships.—*Cambarus zophonastes* has its closest affinities with *Cambarus setosus* Faxon (1899: 237) which is known from a number of localities in the southwestern part of Missouri (Hobbs and Barr, 1960: 27). The similarities between the two are in the widely spaced terminal elements of the first pleopod; the broad, comparatively short antennal scale; the epistome with lateral spines; the contours of the annulus ventralis; and the heavily setose chelipeds. Like the epigean members of the *Asperimanus* Group (*ibid.*, pp. 15–16), the palms of the chelae are provided with a single row of tubercles and the distal two podomeres bear prominent long setae; too, the mesial process is elongate and “situated some distance proximal to the central projection.”

Cambarus zophonastes differs from *C. setosus* in the comparatively broader and shorter rostrum with strongly convergent margins and short acumen (cf. Figs. 1 and 3) and in the shorter terminal elements of the first pleopod of the first form male; in the former, the lateral spines on the carapace immediately caudal to the cervical groove are, for the most part, reduced to small tubercles, only one of which is subspiniform.

Remarks.—In partial support of the assignment of this population of crayfishes to specific rank in preference to relegating it to a subspecies of its close relative, *Cambarus setosus*, are the apparent relationships of its ostracod commensal.

Hart and Hobbs (1961) reviewed the troglobitic entocytherids and described eight new ones. Among the latter were two from the Ozark region, *Uncinocythere pholetera* on *Cambarus hubrichti* and *U. xania* on *C. setosus*. The ostracod on *C. zophonastes* is different from both of these but is more closely allied to *U. pholetera*. This is somewhat unexpected inasmuch as *C. zophonastes* has its closest affinities with *C.*

setosus. One might have anticipated that their commensals would be more closely related than either would be to that on *Cambarus hubrichti*, particularly because *C. zophonastes* and *C. setosus* are presumably both derived from the same parent stock.

Insofar as is known, the ostracods, like their hosts, are largely confined to aquatic habitats, and it seems highly probable that they are transmitted from one host to another by contact or perhaps by a crayfish invading the "lair" of another crayfish. Under such circumstances, one can only conclude that the three associations have been isolated for some period of time. In the absence of intergrades, the three crayfishes and their respective ostracod commensals are each accorded specific rank.

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